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Q. Cal **maximum** angular separation b/w two wavelengths of values 590 nm & 420 nm. for a diffraction grating with grating spacing 1.8×10^{-6} m?

Max. angular separation will always occur in the highest order

590 nm		420 nm
$\frac{n\lambda}{d} < 1$		$\frac{n\lambda}{d} < 1$
$\frac{n(590 \times 10^{-9})}{1.8 \times 10^{-6}} < 1$		$\frac{n(420 \times 10^{-9})}{1.8 \times 10^{-6}} < 1$
$n < 3.01$		$n < 4.3$
$n = 3 \checkmark$		$n = 4$

Suggestion: Just do working with the longer wavelength & this answer will satisfy the other working as well

3rd order is common to both

$$d \sin \theta = n\lambda$$

$$(1.8 \times 10^{-6}) \sin \theta = 3(590 \times 10^{-9})$$

$$\theta = 79.5^\circ$$

$$d \sin \theta = n\lambda$$

$$(1.8 \times 10^{-6}) \sin \theta = 3(420 \times 10^{-9})$$

$$\theta = 44.4^\circ$$

Maximum angular separation

$$= 79.5 - 44.4$$

$$= 35.1$$

Q:- Which **wavelength** in the **3rd order** arrives at the **same angle** as a wavelength of **600 nm** in the **2nd order**?

$$d \sin \theta = n\lambda$$

$$d \sin \theta = (3)(\lambda) \rightarrow \textcircled{1}$$

$$d \sin \theta = (2)(600 \times 10^{-9}) \rightarrow \textcircled{2}$$

d = same (assuming that both wavelengths are incident on the same diffraction grating)
 θ = same (overlap)

Equal $3\lambda = (2)(600 \times 10^{-9})$

$$\lambda = 400 \times 10^{-9} \text{ m}$$

(400 nm).

Q: A diffraction grating has **500 lines per mm** or 500 slits per mm

(i) Show that grating spacing (d) can be written as follows

$$d = 2 \times 10^{-6} \text{ m}$$

Step # 1 Let's find the number of lines / number of slits **per meter**. I will denote this quantity as " N "

N = number of lines per meter

500 lines \rightarrow 1 mm
500,000 \leftarrow 1 m

$$\hookrightarrow \boxed{N = 500,000}$$

Step # 2 $\boxed{d = \frac{1}{N}}$

$$d = \frac{1}{500,000} = 2.0 \times 10^{-6} \text{ m}$$

Q: A grating contains 550 lines per mm. Find the value of grating spacing (d)

Step 1 find N (where N denotes number of lines per meter)

$$N = 550,000 \text{ lines per meter}$$

Step 2 $d = \frac{1}{N}$

$$d = \frac{1}{550,000}$$

$$d = 1.81 \times 10^{-6} \text{ m}$$

$$\boxed{d \sin \theta = n\lambda} \quad \text{1st form}$$

Since $d = \frac{1}{N}$ [N = # of lines per meter]

$$\boxed{\frac{1}{N} \sin \theta = n\lambda} \quad \text{2nd form}$$